A Literature Study On Traffic, Traffic Control Devices, Roundabouts, Pedestrian Access

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Abstract: Traffic is formally organized in many jurisdictions, with marked lanes, junctions, intersections, interchanges, traffic signals, or signs. Traffic is often classified by type: heavy motor vehicle (e.g., car, truck); other vehicle (e.g., moped, bicycle); and pedestrian. Different classes may share speed limits and easement, or may be segregated. Some jurisdictions may have very detailed and complex rules of the road while others rely more on drivers' common sense and willingness to cooperate. Organization typically produces a better combination of travel safety and efficiency. Events which disrupt the flow and may cause traffic to degenerate into a disorganized mess include: road construction, collisions and debris in the roadway. Signs evolved from local practice, cities and states copying neighbors, and inventing what they needed, and then later standardizing (first for rural and urban areas separately, and then jointly) after the value of coordination became apparent when automobile travelers crossed jurisdictional boundaries. From the first center line in Michigan in 1911, stop sign in 1915, a 1923 established the basis of the shapes used for road signs today. The Mississippi Valley Association of State Highway Departments proposed the following. Shapes which were most complex to make (circle, octagon) would indicate most danger and be used least often. This paper deals with literature study on Traffic, Traffic Control Devices, Roundabouts, Pedestrian Access.

Keywords: **Traffic Control Devices; Roundabouts; Pedestrian Access;**

I. INTRODUCTION

Traffic on roads may consist of pedestrians, ridden or herded animals, vehicles, streetcars, buses and other conveyances, either singly or together, while using the public way for purposes of travel. **Traffic laws** are the laws which govern traffic and regulate vehicles, while **rules of the road** are both the laws and the informal rules that may have developed over time to facilitate the orderly and timely flow of traffic. Organized traffic generally has well-established priorities, lanes, right-of-way, and traffic control at intersections. Traffic is formally organized in many jurisdictions, with marked lanes, junctions, intersections, interchanges, traffic signals, or signs. Traffic is often classified by type: heavy motor vehicle (e.g., car, truck); other vehicle (e.g., moped, bicycle); and pedestrian. Different classes may share speed limits and easement, or may be segregated. Some jurisdictions may have very detailed and complex rules of the road while others rely more on drivers' common sense and willingness to cooperate. Organization typically produces a better combination of travel safety and efficiency. Events which disrupt the flow and may cause traffic to degenerate into a disorganized mess include: road construction, collisions and debris in the roadway. On particularly busy freeways, a minor disruption may persist in a phenomenon known as traffic waves. A complete breakdown of organization may result in traffic congestion and gridlock. Simulations of organized traffic frequently involve queuing theory, stochastic processes and equations of mathematical physics applied to traffic flow.

Traffic Control Devices

Traffic control devices include street signs, traffic signals, and road markings. These signs, signals, and stripes guide drivers in navigation and control of their vehicles. Traffic signals are treated above in the section Traffic Signals. Signs and stripings, the other controls, have usage described in the *Manual of Uniform Traffic Control Devices* (MUTCD). Road signs in the United States are standardized in the *Manual on Uniform Traffic Control Devices*. Signs evolved from local practice, cities and states copying neighbors, and inventing what they needed, and then later standardizing (first for rural and urban areas separately, and then jointly) after the value of coordination became apparent when automobile travelers crossed jurisdictional boundaries. From the first center line in Michigan in 1911, stop sign in 1915, a 1923 established the basis of the shapes used for road signs today. The Mississippi Valley Association of State Highway Departments proposed the following. Shapes which were most complex to make (circle, octagon) would indicate most danger and be used least often.

- Round: Used to warn of RR crossing;
- Octagon: Used only to signify a stop;
- Diamond: used to indicate ordinary condition of danger requiring precaution at all times;
- Square: Used to indicate intermittent danger conditions requiring little more than ordinary care;

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- Rectangular: Used to indicate regulatory or directional information;
- Cut-Out; Used a distinctive shape different from the above to identify highway routes.

This system was improved over time. In 1924 the Minnesota Department of Highways published its *Manual of Markers and Signs* with the same shapes, but the white background was made yellow. In 1924, the American Association of State Highway Officials adopted the MVASHD plan (with black on yellow), however Red and green on signs rejected because of visibility at night. Separately, standards were being developed for cities. Traffic signals are largely an urban phenomenon. While the date of the first traffic signal is contested, the electric traffic signal appeared in Cleveland in 1914, and the first three-color traffic signal in 1920. In 1924 the National Conference on Street and Highway Safety developed urban sign recommendations:

- Stop = Red,
- Proceed = Green,
- Caution = Yellow,
- Cross-Roads = Purple or other distinctive color.
- Centerlines = White, but these were to be used only where it was unsafe to be on the left side of the road (curves, hill crests, intersections, railroad crossings)

The objective of AASHO in these early years was first to inventory all of the sign characteristics that had been locally deployed, and then to standardized various aspects: Shape, Word, Color, Symbol, Uniformity of Erection and Application. Even as late as 1930, the third National Conference on Street and Highway Safety, designed for urban published a *Manual on Street Traffic Signs, Signals and Markings* which had either white or black paint for concrete, and white or yellow paint for bituminous. A red border and legend on yellow was suggested for stop signs. Finally, in 1932, a Joint Committee on Uniform Traffic Control Devices met to rectify and combine the separate AASHO and NCSHS manuals for rural and urban traffic into a complete manual. Main initial points were color codes, signs at night, and reduced sign sizes in urban areas. Visibility research was undertaken, sponsored by the Bureau of Public Roads. Minor changes continued after this date, though a modern driver would certainly understand the road at this point. For instance, in the 1954 MUTCD the stop sign changes from black on yellow to white on red; yield sign introduced as triangle (black on yellow), emulating European standards.

Timeline of Traffic Control Devices

- 1911 First center line in Michigan
- 1914 First electric traffic signal installation in Cleveland
- 1915 First stop sign Detroit
- 1920 First three-color traffic signal
- 1923 Shapes agreed to at Mississippi Valley Association of State Highway Departments (Shapes which were most complex to make (circle, octagon) would indicate most danger and be used least often.
- 1924 Minnesota Department of Highways publishes Manual of Markers and Signs (same shapes, white background -> yellow background)
- 1924 AASHO adopts MVASHD (with black on yellow). Red and green on signs rejected because of visibility at night
- 1924 National Conference on Street and Highway Safety developed urban sign recommendations
- 1925: AASHO Manual and Specifications for the Manufacture, Display, and Erection of U.S. Standard Road Markers and Signs ... Tried to build inventory of sign characteristics: Goal of signs: Shape, Word, Color, Symbol, Uniformity of Erection and Application
- 1926 Second National Conference on Street and Highway Safety. Authorized survey from American Engineering Council to collate national practice and make recommendations.
- 1927 Bureau of Public Roads (part of USDA) first national signing manual.
- 1930 Third National Conference on Street and Highway Safety. Publishes Manual on Street Traffic Signs, Signals and Markings. White or black paint for concrete, white or yellow paint for bituminous. Red border and legend on yellow for stop sign. Designed for urban areas.
- 1932 Joint Committee on Uniform Traffic Control Devices met to rectify and combine AASHO and NCSHS separate manuals for rural and urban traffic into a complete manual. Main initial points were color codes, signs at night, and reduced sign sizes in urban areas. Visibility research was undertaken, sponsored by BPR.
- 1935 First Manual on Uniform Traffic Control Devices
- 1942 - War Emergency Edition
- 1948 MUTCD

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- 1954 MUTCD - stop sign changes from black on yellow to white on red; yield sign introduced as triangle (black on yellow), emulating European standards.
- 1961 MUTCD
- 1971 MUTCD
- 1978 MUTCD
- 1988 MUTCD
- 2003 MUTCD

History of Roundabouts

The use of the modern roundabouts began in the 1980s which saw a widespread use in Europe and Australia, and while the United States began implementing the modern roundabout in the early 1990s, their original conception came from the rotaries and traffic circles which were used during early 1900s to 1940s. The modern roundabout is defined as an island in the center traffic where cars enter that area and travel counterclockwise before choosing their exit. There are many designs which are used for roundabouts depending on circumstances such as traffic congestion, crash and fatality rate, and geographical area. The different designs are as follows:

- Mini-roundabouts
- Urban compact roundabouts
- Urban single-lane roundabouts
- Urban double-lane roundabouts
- Rural single-lane roundabouts
- Rural double-lane roundabouts

Reasons for using Roundabouts

The main purpose for using roundabouts is to ease the flow of traffic in certain areas, but there are also many advantages to having roundabouts rather than intersections ranging from safety matters to environmental issues. The drawbacks of installing roundabouts are mainly cleanup duty and the cost. States which experience heavy snowfall and severe weather conditions will be forced to do extra cleanup work as the area taken by roundabouts are generally larger than intersections. Also, the cost of constructing roundabouts can be expensive in some areas, were it is estimated roundabouts cost on average $317,000, while the cost of installing an intersection is pegged at an average of $300,000. However, installing roundabouts offers suitable solutions to city planners in many ways. The major concern for city planners is the safety of all people involved in vehicle conflicts. Two-lane Intersections generate 32 conflict points while roundabouts generate 8 conflict points between vehicles only, which results in 75% less possible crashes that rise from these conflicts. In addition, roundabouts provide less pedestrian to vehicle conflicts as the crosswalks in the roundabouts are farther away from the flow of traffic, and its placement shows potential conflicts with oncoming vehicles that are planning to enter the roundabout. Such measures that are implicitly built in the roundabout design provide greater safety to the vehicles as well as the pedestrians. Also, the nature of the roundabout forces oncoming traffic to slow down to enter it, thereby eliminating traffic congestion and the use of stop signs. Yield signs are used instead of stop signs, which during heavy traffic may cause congestion, and yield sign allows vehicles to drive freely if the space in the roundabout is available. The environmental aspect of roundabouts can be considerable depending on the traffic flow and number of vehicles that use the roundabout. The Insurance institute for highway safety states that studies have shown roundabouts reduce the consumption of fuel by 235,000 gallons in one year as opposed to intersection when the study was conducted on intersection that were to be converted to roundabouts . There reasons are simple, continuous flow of traffic reduces traffic delays and vehicles stops, which in turn reduces the amount of fuel burned by the vehicle as opposed to when it is still at an intersection waiting for a green light. Therefore, having roundabouts can be environmentally friendly and economically sound for vehicle operators.

Safety Statistics

Roundabouts offer less conflicts among vehicles and pedestrians, therefore naturally crashes tend to be reduced. Based on 10 samples, the average crash rate in roundabouts is 0.13 crashes per million vehicles, which present 40% less crashes, 75% less crashes with injuries and almost no fatalities when compared to intersection due to the fact that roundabouts eliminate the possibility of vehicles colliding head on. The only type of roundabout collision experienced would be a side collision which in general is much safer than a head on collision.

Concerns about Roundabouts

While roundabouts reduce conflict possibilities, they do not eliminate them. The disregard for stop signs allows reckless drivers to drive through roundabouts without paying attention to traffic within the roundabout, which may cause problems. In addition, the size of the island which vehicles drive around may block the line of sight of vehicles trying to enter the roundabout, which under some circumstances may cause crashes. Finally, the location and size of the roundabout has to be considered carefully before being implemented as certain vehicles (large trucks, firefighter trucks, emergency vehicles etc) may have difficulties

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driving around the roundabouts if they were improperly placed. Finally, in 1972, the town Swindon in the United Kingdom saw the installation of the first "magic roundabout" which consisted of six mini-roundabouts which are installed around one central island where drivers drive counterclockwise around the central island and clockwise around the mini-roundabouts. although Swindon residents find the roundabout quite useful, tourists as well as outsiders have consistently complained about the dangers that might rise from such a roundabout since it is one of a kind, and not all drivers are accustomed to operating vehicles around such a roundabout. A poll conducted by the Britannia Rescue places the Magic Roundabout at the fourth scariest road in 2009.

Pedestrian Access

The research findings on pedestrian safety at roundabouts are somewhat unclear. There have been relatively few studies, mostly conducted in Europe, concerning pedestrians and roundabouts. Pedestrian-vehicle crashes, the most commonly used dependent measure in pedestrian safety studies, tend to occur infrequently both before and after an intersection is converted to a roundabout. As a result, it is difficult to draw firm conclusions from the literature regarding pedestrian safety and roundabouts. One issue that is often not considered in pedestrian research is the degree to which pedestrian volume changes when intersections with signal or stop-sign control are converted to roundabouts. There is a need for research on this topic as well as a broad range of other pedestrian-related concerns at roundabouts. Little is known about the effect of roundabouts on older pedestrians, children, and pedestrians with disabilities. Anecdotal evidence indicates that many Australian engineers (who have extensive experience with roundabouts) consider these intersections to be unsuitable if large numbers of pedestrians are present, however some improvements can be helpful especially when considering pedestrians with disabilities.

Improvements for wayfinding

- Well-defined walkway edges
- Separated walkways, with landscaping at street edge to preclude prohibited crossings to center island
- Tactile markings across sidewalk to identify crossing locations
- Bollards or architectural features to indicate crossing locations
- Detectable warnings (separate at splitter islands) at street edge
- Perpendicular crossings ; where angled, use curbing for alignment cues
- High-contrast markings
- Pedestrian lighting

Orientation and mobility techniques used by blind individuals at traditional intersections rely heavily on traffic sounds. When traffic signals and stop signs regulate traffic movements at intersections, the resulting breaks in traffic flow provide identifiable and predictable periods – gaps – during which pedestrians can cross. Such predictable breaks do not usually occur at roundabouts, and so pedestrians must make judgments about the speed and travel paths of approaching vehicles (and the duration of gaps between vehicles). It appears that sighted adults are generally able to safely make such judgments, although some pedestrians may have difficulty doing so. Research suggests that the selection of appropriate gaps at roundabouts is problematic for blind pedestrians at some roundabouts.

II. CONCLUSIONS

Traffic on roads may consist of pedestrians, ridden or herded animals, vehicles, streetcars, buses and other conveyances, either singly or together, while using the public way for purposes of travel. Traffic laws are the laws which govern traffic and regulate vehicles, while rules of the road are both the laws and the informal rules that may have developed over time to facilitate the orderly and timely flow of traffic. Organized traffic generally has well-established priorities, lanes, right-of-way, and traffic control at intersections. Traffic is formally organized in many jurisdictions, with marked lanes, junctions, intersections, interchanges, traffic signals, or signs. This literature study on Traffic, Traffic Control Devices, Roundabouts, Pedestrian Access will give good awareness to readers.

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